Seat No.	

Total No. of Pages : 14

P.G. Entrance Examination 2025
M.Sc. Mathematics
Subject Code : 58716

Instructions :
1) All questions are compulsory.
2) Each question carries 1 mark.
3) Answers should be marked in the given OMR answer sheet by darkening the appropriate option.
4) Follow the instructions given on OMR sheet.
5) Rough work shall be done on the sheet provided at the end of question paper.

Day and Date : Thursday, 15-May-2025 **Total Marks : 100**
Time : 01.00 pm to 02.30 pm

1. Geometrically the Langranges Mean Value Theorem (LMVT) means that the tangent at point $x = c$ to the curve $y = f(x)$ is______________.
   A) intersecting to chord AB B) perpendicular to chord AB
   C) not related to chord AB D) parallel to chord AB

2. If $x = u + v$ and $y = u - v$ then the Jacobian $\frac{\partial(x,y)}{\partial(u,v)}$ is _______.
   A) 0 B) 1 C) 2 D) -2

3. The degree of the homogeneous function $\frac{x+y}{\sqrt{x}+\sqrt{y}}$ is __________.
   A) $\sqrt{2}$ B) 1 C) $\frac{1}{2}$ D) -$\frac{1}{2}$

4. The value of $\left(\sin\frac{\pi}{6} + i\cos\frac{\pi}{6}\right)^6$ is_________.
   A)1 B)-1 C)0 D)i

5. The solution of the equation $\cos(y - px) = p$ is___________.
   A) $y = cx - cos^{-1}c$ B) $y = cx + cos^{-1}c$
   C) $y = cx + \cos c$ D) $y = cx + (cos^{-1}c)^2$

6. The complementary function (C.F.) of the equation $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = e^{4x}$ is_______.
   A) $y = c_1e^{3x}+c_2e^{2x}$ B) $y = c_1e^{-3x}+c_2e^{-2x}$
   C) $y = c_1e^{3x}+c_2e^{-2x}$ D) $y = c_1e^{-3x}+c_2e^{2x}$

7. If g. c. d. of two integers a and b is 1 then a, b are called _________.

A) composite integers B) prime integers

C) relatively prime integers D) associates

8. If $u = \left(\frac{x^4+y^4}{x+y}\right)$ then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} =$________________.

A) u B) $2u$ C) $3u$ D) u^3

9. If $y = \sin 6x$ then $y_{18}=$_______ _______.

A) 6^{18} B) $6^{18} \cdot \sin(6x + 9\pi)$ C) $\sin 18\,x$ D) $3^{18} \cdot \cos 6x$

10. P.I. of $\frac{1}{D^2+a^2} cosax$ is __________________ .

A) $\frac{x}{2a} sinax$ B) $\frac{-x^2}{2!}\frac{1}{4a^2} sinax$ C) $\frac{x}{2a} cosax$ D) $\frac{-x^2}{2!}\frac{1}{4a^2} cosax$

11. In solving $\frac{d^2y}{dx^2} + P\frac{dy}{dx} + Qy = R$, by change of dependent variable method, the complete solution is given by $y = uv$ where $u =$...............

A) $e^{\int Pdx}$
B) $e^{\frac{1}{2}\int Pdx}$
C) $e^{-\int Pdx}$
D) $e^{-\frac{1}{2}\int Pdx}$

12. Method of taking one variable as constant is useful in solving.................. equation.

A) simultaneous
B) total differential
C) homogeneous linear
D) linear equation with constant coefficients

13. Let $y_0, y_1, \ldots \ldots \ldots, y_n$ be set of values of $y = f(x)$. Then $\Delta^2 y_0 =$……………

A) $y_2 - 3y_1 + y_0$
B) $y_3 - 2y_2 + y_1$
C) $y_2 - y_0$
D) $y_2 - 2y_1 + y_0$

14. A vector point function $\bar{f}$ is said to be solenoidal if…........

A) curl $\bar{f} = 0$
B) curl $\bar{f} = 1$
C) div $\bar{f} = 0$
D) div $\bar{f} = 1$

15. Value of div grad f is...............

A) $\nabla^2 f$
B) 0
C) grad div f
D) none of these

16. Value of $\int (x\,dy - y\,dx)$ around the circle $x^2 + y^2 = 1$ is ....

A) 0
B) $\frac{\pi}{2}$
C) π
D) 2π

17. $\beta(m+1, n) =$ ....

A) $\frac{1}{m+n}\beta(m,n)$
B) $\frac{m}{m+n}\beta(m,n)$
C) $\frac{n}{m+n}\beta(m,n)$
D) $\frac{mn}{m+n}\beta(m,n)$

18. The value of $\lceil 5/2$ is equal to ……………

A) $\frac{3}{4}\sqrt{\pi}$
B) $\frac{15}{8}\sqrt{\pi}$
C) $\frac{8}{15}\sqrt{\pi}$
D) None of the above

19. If $\int_0^\infty e^{-ax}\,dx = \frac{1}{a}$, then $\int_0^\infty e^{-ax}\,x^n dx =$ ....

A) $\frac{n!}{a^n}$
B) $\frac{(n+1)!}{a^n}$
C) $\frac{n!}{a^{n+1}}$
D) $\frac{(n-1)!}{a^n}$

20. erf (0) =...............

A) 0
B) 1
C) -1
D) ∞

21. If $f(x) = x^2$ for all $x \in \mathbb{R}$, then the image set of $\{-2, 0, 3\}$ is ________.

A) $\{-2, 0, 3\}$
B) $\{0, 4, 3\}$
C) $\{-4, 0, 3\}$
D) $\{0, 4, 9\}$

22. If $f: A \to B$ and $A \subseteq C$, then a function $g: C \to B$ such that $g(x) = f(x)$ for all $x \in A$ is called__________.

A) restriction of f
B) extension of f
C) inverse of f
D) identity map

23. Which of the following sequence is convergent?

A) $\{(-1)^n\}_{n=1}^{\infty}$
B) $\{n\}_{n=1}^{\infty}$
C) $\left\{\frac{1}{n}\right\}_{n=1}^{\infty}$
D) $\{n^2\}_{n=1}^{\infty}$

24. A non-decreasing sequence which is bounded above is ________.

A) convergent
B) diverges to ∞
C) diverges to $-\infty$
D) oscillatory

25. If a sequence $\{S_n\}_{n=1}^{\infty}$ converges to 2 then $\lim\sup_{n\to\infty} S_n =$ _______.

A) 2
B) -2
C) 12
D) $\frac{1}{2}$

26. The sequence 1, 0, 1, 0, 1, 0, … is __________.

A) (C, 1) summable to 1
B) (C, 1) summable to 0
C) not (C, 1) summable
D) (C, 1) summable to $\frac{1}{2}$

27. Consider the two statements:

(I) Every Cauchy sequence of real numbers is convergent.
(II) Every convergent sequence of real numbers is a Cauchy sequence.
Then ______.

A) only (I) is true
B) only (II) is true
C) both (I) and (II) are false
D) both (I) and (II) are true

28. If $\sum_{n=1}^{\infty} a_n$ is a convergent series, then $\lim_{n \to \infty} a_n =$ _______.

A) 1
B) 0
C) ∞
D) $-\infty$

29. The series $\sum_{n=0}^{\infty} \frac{1}{4^n}$ __________.

A) diverges to ∞
B) converges to 4
C) converges to $4/3$
D) diverges to $-\infty$

30. If $\{a_n\}_{n=1}^{\infty}$ is a nonincreasing sequence of positive real numbers and if $\sum_{n=1}^{\infty} a_n$ converges, then $\lim_{n \to \infty} na_n =$

A) 0
B) 1
C) ∞
D) $-\infty$

31. Centre of group $S_3 = \{I, (12), (13), (23), (123), (132)\}$ is ______

A) $\{I, (12), (13), (23)\}$
B) $\{I\}$
C) $\{(123), (132)\}$
D) S_3

32. If G is a group of order p (prime), then it will have only _____ subgroups.

A) one
B) p
C) two
D) infinite

33. If H and K are finite subgroups of a group G then which of the following statement is correct?

A) $\mathrm{o(HK)} = \frac{\mathrm{o(H \cap K)}}{\mathrm{o(H).o(K)}}$
B) $\mathrm{o(HK)} = \frac{\mathrm{o(H).o(K)}}{\mathrm{o(H \cap K)}}$
C) $\mathrm{o(H \cap K)}$
D) $\mathrm{o(H).o(K)}$

34. Consider the cyclic group $\boldsymbol{Z_8} = \{0, 1, 2, ...7\}$ under addition modulo 8. Then which of the following is not the generator of $\boldsymbol{Z_8}$.

A) 1
B) 2
C) 3
D) 5

35. Consider the following statements for a group G of prime order

I) G is abelian.
II) G is cyclic

Then
A) Only I) is true
B) Only II) is true
C) Both I) and II) are true
D) Both I) and II) are false

36. Number of generators of a finite cyclic group of order n is _____.

A) $\varphi(n)$
B) infinity
C) 1
D) $\varphi(1)$

37. _____ theorem states that "Let a, n $(n \geq 1)$ be any integers such that $g.c.d.(a, n) = 1$. Then, $a^{\varphi(n)} \equiv 1(mod\ n)$".

A) Euler's
B) Fermat's
C) Cayley's
D) Lagrange's

38. An onto homomorphism is called ______.

A) endomorphism
B) automorphism
C) epimorphism
D) monomorphism

39. Which of the following is a unit in $\boldsymbol{Z_8}$.

A) 0
B) 2
C) 5
D) 4

40. Consider the ring $Z_7 = \{0, 1, 2, 3, 4, 5, 6\}$ under addition and multiplication modulo 7. Then $6 \odot_7 2 =$ _____.

A) 3
B) 6
C) 1
D) 5

41. Consider the function

$$f(t) = \begin{cases} t^2, & 0 \le t < 1, \\ 2t - 2, & 1 \le t < 2, \\ 3t^2 - 4, & 2 \le t < 3. \end{cases}$$

Then_________

A) $f(t)$ is continuous at $t = 1$ B) $f(t)$ is continuous at $t = 2$
C) $f(t)$ is continuous on $[0,3]$ D) $f(t)$ is piecewise continuous in $[0,3]$

42. $L^{-1}\left\{\frac{1}{s^{\frac{3}{2}}}\right\} =$ _______.

A) $\sqrt{\frac{t}{\pi}}$ B) $2\sqrt{\frac{t}{\pi}}$ C) $\sqrt{t\pi}$ D) $2\sqrt{t\pi}$

43. If $f(s)$ is Fourier transform of $F(x)$, then the Fourier transform of $F(ax)$ is_________

A) $af\left(\frac{s}{a}\right)$ B) $\frac{1}{a}f(as)$ C) $\frac{1}{a}f\left(\frac{s}{a}\right)$ D) $af(as)$

44. $L\{\cos^2 2t\} =$ __________ .

A) $\frac{s}{s^2+4}$

B) $\frac{1}{s} + \frac{s}{s^2+4}$

C) $\frac{1}{2}\left(\frac{1}{s} + \frac{s}{s^2+4}\right)$

D) $\frac{1}{2}\left(\frac{1}{s} + \frac{s}{s^2+16}\right)$

45. $L^{-1}\{\log(s + a)\} =$ ________

A) $t\,e^{-at}$ B) $-te^{-at}$ C) $\frac{e^{-at}}{t}$ D) $\frac{-e^{-at}}{t}$

46. If $L\{F(t)\} = \frac{e^{-\frac{1}{s}}}{s}$, then $L\{F(3t)\} =$ ________.

A) $\frac{e^{-\frac{1}{s}}}{s}$ B) $\frac{e^{-\frac{3}{s}}}{s}$ C) $\frac{e^{-\frac{1}{3s}}}{s}$ D) $\frac{e^{-\frac{1}{3s}}}{3s}$

47. If $f(s)$ is Fourier transform of $F(x)$ then Fourier transform of $F(x)\cos ax$ is______

A) $\frac{1}{2}[f(s-a)-f(s+a)]$ B) $\frac{1}{2}[f(s-a)+f(s+a)]$

C) $\frac{1}{2}[f(s+a)-f(s-a)]$ D) $-\frac{1}{2}[f(s-a)+f(s+a)]$

48. If $L^{-1}\{f(s)\}=\sin t$, then $L^{-1}\left\{\frac{f(s)}{s}\right\}=$ _____

A) $1-\cos t$ B) $1+\cos t$ C) $\cos t$ D) $\frac{\sin t}{t}$

49. The inversion formula for the infinite Fourier cosine transform is ________

A) F(x) = $\frac{1}{\pi}\int_0^\infty F_c(F(x))\cos x\,ds$ B) F(x) = $\frac{2}{\pi}\int_0^\infty F_c(F(x))\cos sx\,ds$

C) F(x) = $\frac{2}{\pi}\int_0^\infty F_c(F(x))\cos x\,ds$ D) F(x) = $\frac{1}{\pi}\int_0^\infty F_c(F(x))\cos sx\,ds$

50. $L\left\{\frac{\sin 3t}{t}\right\}=$ _________.

A) $\cot^{-1}(\frac{s}{3})$ B) $\tan^{-1}(\frac{s}{3})$ C) $\sin^{-1}(\frac{s}{3})$ D) $\cos^{-1}(\frac{s}{3})$

51. Which of the following complex number satisfies the equation $z^2+2z+2=0$?

A) $z=1-i$ B) $z=i-1$ C) $z=1+i$ D) $z=i-2$

52. Which of the following function of a complex variable z is only differentiable at $z=0$?

A) z^2 B) $\cos z$ C) $e^z+\sin z$ D) $|z|^2$

53. If $f(z)=u(x,y)+iv(x,y)$ is such that both $u(x,y)$ and $v(x,y)$ satisfies Cauchy Riemann equations and if $u_x(x,y)=2x$ and $u_y(x,y)=-2y$ then for any $z=(x,y)$, the value of $f'(z)=\cdots$

A) $2z$ B) $-2z$ C) 0 D) $2\bar{z}$

54. An analytic function with constant argument is …

A) purely imaginary B) constant C) only a zero function D) an identity function

55. $\int_0^1 (1+it)^2\,dt=\cdots$

A) $\frac{2}{3}-i$ B) $\frac{2}{3}+i$ C) $\frac{4}{3}-i$ D) $\frac{4}{3}+i$

56. Isolated singularities of $f(z)=\frac{z^2+2z+1}{(z+2)(z^2-9)}$ are ...

A) $z = 2, -2, 3$ `B) $z = 2, -2, -3$ C) $z = -2, -3, 3$ D) $z = 2, -2, 3$

57. The sequence of complex numbers $z_n = -\frac{1}{n} + i\left(1 - \frac{1}{n}\right), n = 1,2, \ldots$ is …

A) divergent B) converges to i C) converges to -1 D) oscillatory

58. If $f(z)=\frac{z^2-3}{(z+2)^6(z^2-2)^4}$ then $z = -2$ is a pole of order...

A) 1 B) 6 C) 5 D) 11

59. The value of the integral $\int_C \frac{dz}{z\ \ (z+4)}$ taken counterclockwise around the circle $|z| = 2$ is …..

A) $\frac{\pi i}{2}$ B) $2\pi i$ C) $-\frac{\pi i}{2}$ D) $\frac{2\pi i}{3}$

60. The function $f(z) = \frac{Z(z^2-1)}{(z+2)(z-3)}$ has ...simple zeros.

A) $z = 0, 1, -1$ B) $z = 0, i, -i$ C) $z = -2, 3$ D) $z = i, -i$

61. The set S ={ (1,2), (3,4), (5,6)} of vectors in R^2 is ________.

A) a linearly independent subset .

B) a basis of R^3.

C) a linearly dependent subset.

D) an orthogonal set.

62. If $T : R2 \rightarrow R^2$ isa linear transformation and $\{ e_1 = (1,0),\ e_2 = (0,1)\}$ is standard basis of $R^{2.}$ If $T(e_1) = (1,2)$ and $T(e_2) = (2,3)$, then $T(x,y) =$ _______ .

A) $(2x + y, 2x + 3y)$ B) $(2x, 3y)$

C) $(x + 2y, 2x + 3y)$ D) $(x + y, x - y)$.

63. Hom (V, W), where V and W are vector spaces over field F is called dual space over F, if ______.

A) V = F B) W = F C) W ≠ F D) none of these.

64. The norm of vector (4, 2, 2, -6) is ________.

A) 60 B) $2\sqrt{15}$ C) 14 D) $4\sqrt{15}$

65. If A = $\begin{bmatrix} 3 & 0 \\ 0 & -2 \end{bmatrix}$ then the characteristic polynomial of A is _______.

A) $x^2 - 6$. B) $x^2 + 6$. C) $x^2 - x - 6$ D) $x^2 + 5x - 6$.

66. If $\lambda = 1/5$ is an eigen value of an invertible operator T then eigen value of T^{-1} is _________.

A) -5 B) 1/5 C) 5 D) -1/5

67. If $T: U \rightarrow V$ isa linear transformation such that $dim\ U = 4$ and nullity of $T = 2$ then rank of T is _____.

A) 1 B) 2 C) 0 D) 4.

68. If S is orthonormal set then for any $\propto \in S$ _________ .

A) $\|\propto\| = 1$ B) $\|\propto\| \geq 2$ C) $\|\propto\| = 0$ D) $\|\propto\| < 1$

69. Inner product space over real field is called _________.

A) Null space B) Euclidean space
C) Unitary space D) subspace

70. If S is orthogonal set of non zero vectors in an inner product space V then ___________.

A) S is linearly independent set B) S is linearly dependent set
C) S is empty set D) none of these

71. The general form of a first-order partial differential equation in two variables is-----------

A) F(x, y, u) = 0 B) F(p, q, u) = 0
C) F(x, y, u, p, q) = 0 D) $F\left(x, y, u, \frac{\partial^2 u}{\partial x^2}\right) = 0$

72. The method of finding particular integral (PI) for a non-homogeneous linear partial differential equation with constant coefficients is-----------

A) Separation of variables B) Charpit's method
C) Operator method D) Runge-Kutta method

73. To form a partial differential equation by eliminating arbitrary constants, we use ---------

A) Total differentiation B) Partial differentiation
C) Successive partial derivatives D) Both B and C

74. The general solution of the partial differential equation $\frac{\partial^2 u}{\partial x^2} - 2\frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} = 0$ involves --------

A) Real and distinct roots B) Repeated roots
C) Complex roots D) No real roots

75. If the right-hand side is of the forme^{ax+by}, then PI is found by-------------

A) Multiplying by inverse operator
B) Trial method
C) Substituting D=a, D′=b
D) Both A and C

76. Which of the following is a non-linear partial differential equation of first order?

A) $p + q = u$
B) $p^2 + q^2 = 1$
C) $p + q + u = 0$
D) $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 0$

77. A singular solution of a partial differential equation is------------

A) A specific case of the general solution
B) A solution that cannot be obtained from the complete integral
C) The same as the complete solution
D) Always a constant solution

78. The function $z = e^{\{x + y\}}$ is a solution to the equation $(D - D')z = 0$ because-------

A) It satisfies the non-homogeneous part
B) D z = D' z
C) It's a general solution
D) None of these

79. For the partial differential equation $(D^2 - 2\,D\,D' + D'^2)\,u = 0$, the solution involves functions of--------

A) $x + y$
B) $x - y$
C) $x^2 + y^2$
D) $x^2 - y^2$

80. The partial differential equation $p^2 + q^2 + u = 0$ is-------------

A) Linear
B) semi-linear
C) Fully non-linear
D) Quasi-linear

81. In the discrete metric space, an open ball B[x;1] is-------------.

A) the entire space
B) a singleton set {x}
C) all points at distance less than 1
D) empty set

82. A set B in a metric space is closed if it -------------.

A) contains all its limit points
B) is a union of open balls
C) is bounded
D) is not open

83. Let < M, ρ> be a metric space and let $\{s_n\}_{n=1}^{\infty}$ be a sequence of points in M then we say that sequence s_n approaches L ∈ M as n approaches infinity, if given ∈ > 0 there exists N ∈ I such that ------.

A) $\rho(s_n, L) > \in$, (n≥ N)
B) $\rho(s_n, L) = \in$, (n≥ N)
C) $\rho(s_n, L) < \in$, (n≥ N)
D) $\rho(s_n, L) < \in$, (n∈ I)

84. Every Cauchy sequence in any metric space is -------------.

A) divergent
B) convergent
C) oscillatory
D) need no be convergent

85. If M is the closed interval $[0,1]$ with absolute value metric, then the open ball $B\left[\frac{1}{2};\frac{1}{4}\right]$ is the interval -------------.

A) $\left[0,\frac{3}{4}\right]$
B) $\left(0,\frac{3}{4}\right)$
C) $\left(\frac{1}{4},\frac{3}{4}\right)$
D) $\left(0,\frac{3}{4}\right]$

86. If A is not bounded subset of a metric space M then diam(A) is ------.

A) less than zero
B) zero
C) infinity
D) one

87. If A is not a connected subset of R^1 then----------------.

A) A may be a singleton set
B) A may be union of intervals with nonempty intersection
C) A may be an interval
D) A may be union of intervals with empty intersection

88. A subset S = { 1, 2, . . . , 10} in discrete metric space is -----------.

A) compact
B) open
C) connected
D) need not be open

89. In a usual metric space R^1, the set A = (0, 1] ∪ [1, 2] is ------------.

A) an open set in R^1
B) a connected set in R^1
C) a closed set in R^1
D) a compact set in R^1

90. In any metric space arbitrary intersection of closed sets is ---------.

A) open
B) not open
C) closed
D) not closed

91. In a Linear Programming Problem (LPP), the feasible region is defined by:

A) Only equality constraints
B) Only inequality constraints
C) A combination of equality and inequality constraints
D) The objective function

92. Which of the following is NOT a requirement for a standard LPP?

A) Linearity of the objective function
B) Non-negativity constraints
C) Integer-valued decision variables
D) Constraints must be linear

93. The graphical method for solving LPP is suitable for problems with:

A) Two decision variables
B) Three decision variables
C) More than three decision variables
D) Only one decision variable

94. In the Simplex method, the variable entering the basis is selected based on:

A) The smallest coefficient in the objective function
B) The most negative coefficient in the objective row
C) The largest coefficient in the objective function
D) A random selection

95. A factory produces two products A and B with profits of ₹6 and ₹4 per unit respectively. The production constraints are:

- $3A + 2B \leq 120$ (Machine hours)
- $A + 2B \leq 80$ (Labor hours)

What is the optimal production mix for maximum profit?

A) A=20, B=30

B) A=30, B=20

C) A=40, B=10

D) A=10, B=40

96. In a transportation problem, the number of basic variables in a feasible solution is:

A) $m+n$

B) $m \times n$

C) $m-n$

D) $m+n-1$

97. The North-West Corner Rule is used to find:

A) An optimal solution for a transportation problem

B) The shadow prices in a transportation problem

C) An initial basic feasible solution for a transportation problem

D) The dual of a transportation problem

98. The Hungarian method is used to solve:

A) Transportation problems

B) Assignment problems

C) Network problems

D) Inventory problems

99. In a maximization assignment problem, the objective is to:

A) Maximize the total profit

B) Minimize the total cost

C) Balance the assignments

D) Assign tasks randomly

100 The Travelling Salesman Problem (TSP) aims to:

A) Minimize transportation costs

B) Find the shortest possible route visiting each city exactly once

C) Assign jobs to workers optimally

D) Solve a linear programming problem

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